Learning Enhancement Team

*Steps into Numeracy*

Types of Fractions

This guide introduces fractions and gives examples of the different types of fractions you may encounter.

What is a fraction?

Fractions represent the division of one whole number by another whole number. They are usually numbers which occur between whole numbers, but they can also be used to represent the whole numbers themselves. A fraction comprises three parts: the **numerator** (the top part of the fraction), the **denominator** (the bottom part of the fraction) and the **dividing line** which separates them. It is important to understand that the denominator of a fraction can never equal 0.
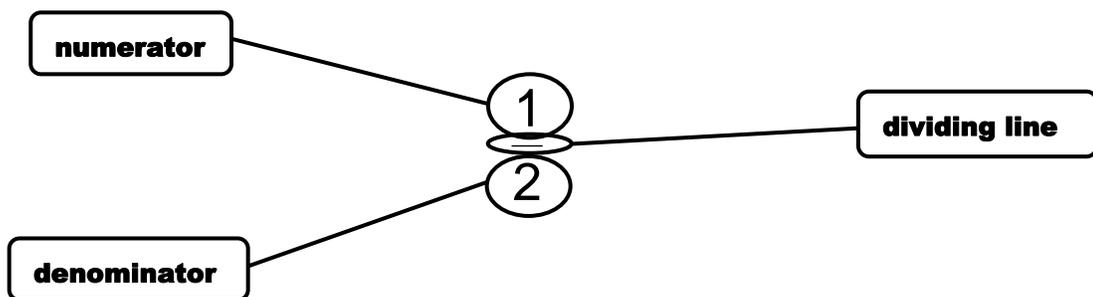
The fraction above is one half: you can see that the numerator is 1 and the denominator is 2. The dividing line tells you that the fraction represents "one divided by two".

The numerator and denominator also contain other information about the fraction. The denominator identifies the type of fraction being written: a denominator of 3 indicates *thirds*, 4 indicates *quarters*, 5 indicates *fifths* and so on. The *num*erator gives the *num*ber of that type of fraction, so $\frac{3}{5}$ is not only read as three divided by five, but also as three lots of fifths, or simply three fifths. Understanding the different types of information that a fraction contains will make it easier for you to add, subtract, multiply or divide them. Also, make sure that the dividing line is *horizontal* – this will help your understanding and manipulation of fractions immensely. Many problems with fractions can be avoided by following this simple rule.

Proper fractions

If the numerator is *smaller* than the denominator, the fraction is said to be a **proper fraction,** assuming both the numerator and denominator are positive (we will deal with negatives later). Proper fractions represent numbers between 0 and 1. Examples of proper fractions are $\frac{1}{2}$ (one half), $\frac{5}{6}$ (five sixths) and $\frac{7}{20}$ (seven twentieths).

The number 1

If the numerator and denominator are equal, the fraction always represents the number 1. This is true for any value of numerator and denominator. For example, $\frac{2}{2} = 1$ (two halves equal 1), $\frac{6}{6} = 1$ (six sixths equal 1), $\frac{20}{20} = 1$ (twenty twentieths equal 1) and so on.

Improper fractions

If the numerator is *larger* than the denominator the fraction is said to be an **improper fraction**, assuming both the numerator and denominator are positive. Improper fractions represent numbers greater than 1, and are sometimes called **top-heavy fractions**. Examples of improper fractions are $\frac{3}{2}$ (three halves), $\frac{11}{6}$ (eleven sixths) and $\frac{61}{20}$ (sixty-one twentieths).

Mixed fractions

Mixed fractions comprise two parts: a whole number which is followed by a fraction. Improper fractions represent numbers which can also be written as a mixed fraction, as part whole number and part fraction. Mixed fractions are, however, an inefficient way of writing fractions. This is because it is much easier to perform any mathematics on improper fractions than on mixed fractions.

Take the improper fraction $\frac{7}{4}$: as you have seen, this represents seven quarters. As four of these quarters make 1 you could say that $\frac{7}{4}$ is one with three quarters remaining. This is written as $1\frac{3}{4}$, a mixed fraction. You must recognise that mixed fractions conceal addition. $1\frac{3}{4}$ is one plus three quarters or $1\frac{3}{4} = 1 + \frac{3}{4}$.

It is useful to know that mixed fractions exist and what they mean, but it is better to write mixed fractions in their improper form.

Describing whole numbers as fractions

When doing arithmetic which involves whole numbers *and* fractions, it is necessary to represent the whole numbers as fractions. Any whole number can be written as a fraction because any number divided by 1 remains itself. Writing a whole number as a fraction then becomes easy – you simply divide it by 1, representing this division by the dividing line. For example, $3 = \frac{3}{1}$, $5 = \frac{5}{1}$ and so on.

Equivalent fractions

If you multiply the numerator and denominator of a fraction by the same (non-zero) number you produce a fraction which looks different but has exactly the same value. For example, take $\frac{1}{3}$: if you multiply the numerator *and* the denominator by 2 you get $\frac{2}{6}$, as $1 \times 2 = 2$ (which is the new numerator) and $3 \times 2 = 6$ (which is the new denominator). Here, $\frac{1}{3}$ and $\frac{2}{6}$ are known as **equivalent fractions**: they have exactly the same value but are expressed differently. In order to be able to add and subtract fractions, understanding equivalent fractions is essential (see study guide: *Adding and Subtracting Fractions*).

Negative signs and fractions

If either the numerator or denominator in a fraction is a negative number then the fraction represents a number less than zero; the fraction itself can be thought of as negative. In these situations it can be confusing to know where to write the negative sign. Mathematical convention is that a negative fraction should have the negative sign before the fraction, placed level with the dividing line. For example:

$$\frac{-2}{3} \text{ is equivalent to } \frac{2}{-3} \text{ and should be written as } -\frac{2}{3} \text{ to avoid confusion.}$$

If both the numerator *and* denominator are negative then the negative signs negate each other, which results in a positive fraction. For example:

$$\frac{-2}{-3} \text{ is equivalent to } \frac{2}{3}$$

Proper and improper negative fractions

A proper negative fraction has a value between -1 and 0, such as $-\frac{1}{2}$, $-\frac{5}{6}$ and $-\frac{7}{20}$.

An improper negative fraction has a value of less than -1, such as $-\frac{3}{2}$, $-\frac{11}{6}$ and $-\frac{61}{20}$.

Want to know more?

If you have any further questions about this topic you can make an appointment to see a **Learning Enhancement Tutor** in the **Student Support Service**, as well as speaking to your lecturer or adviser.

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